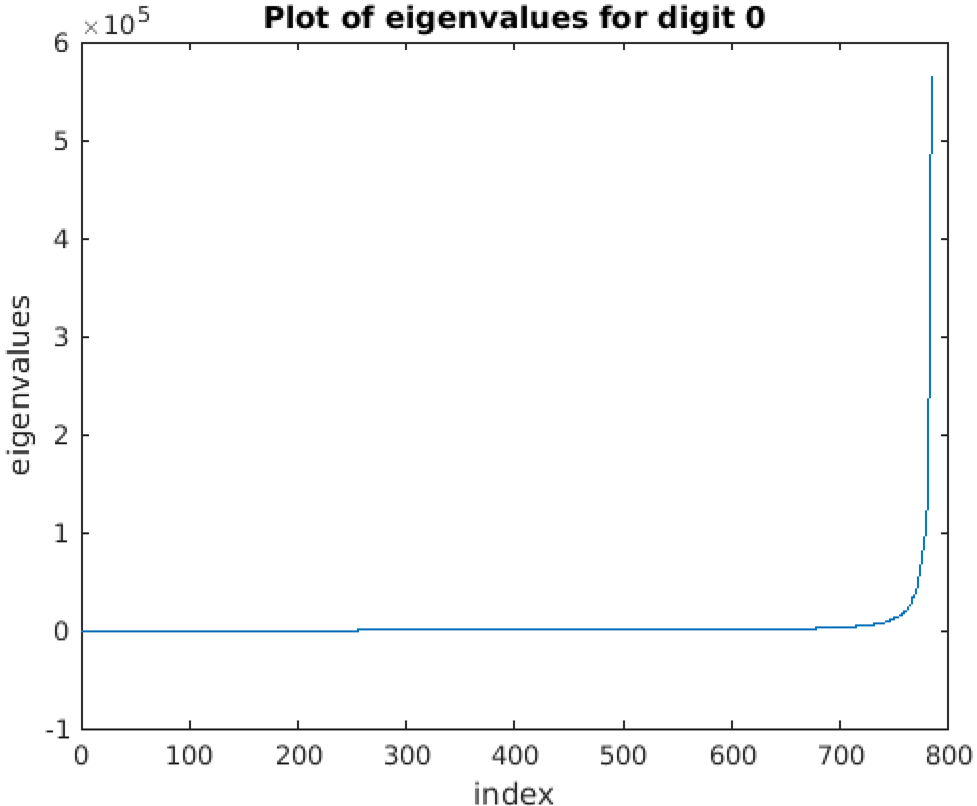
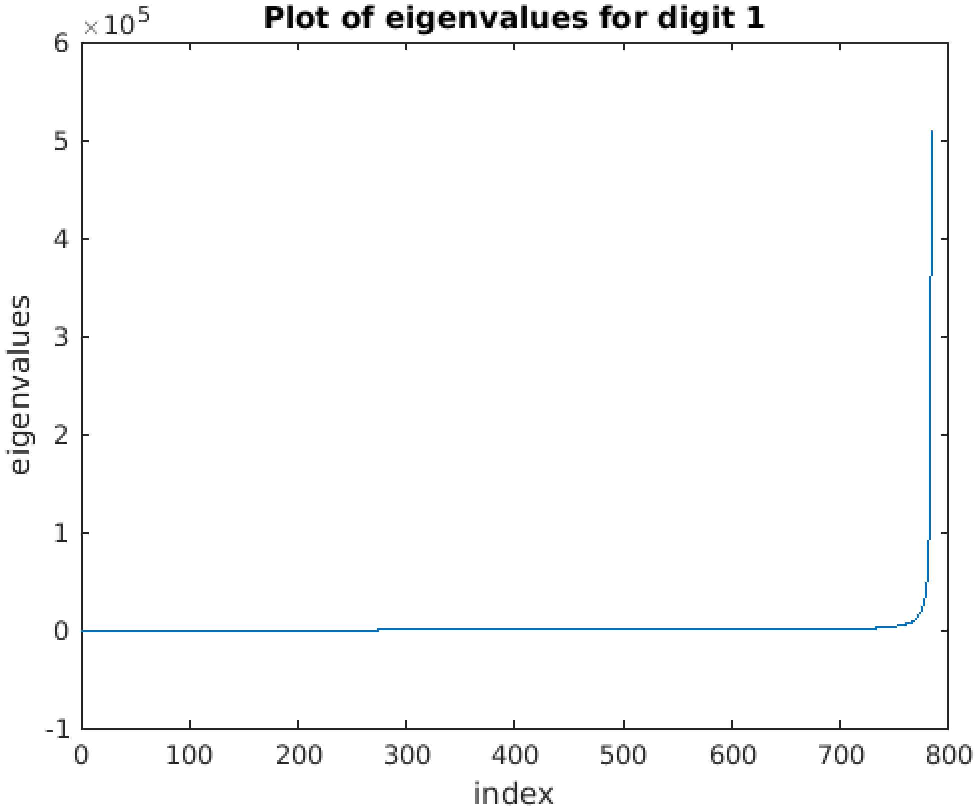
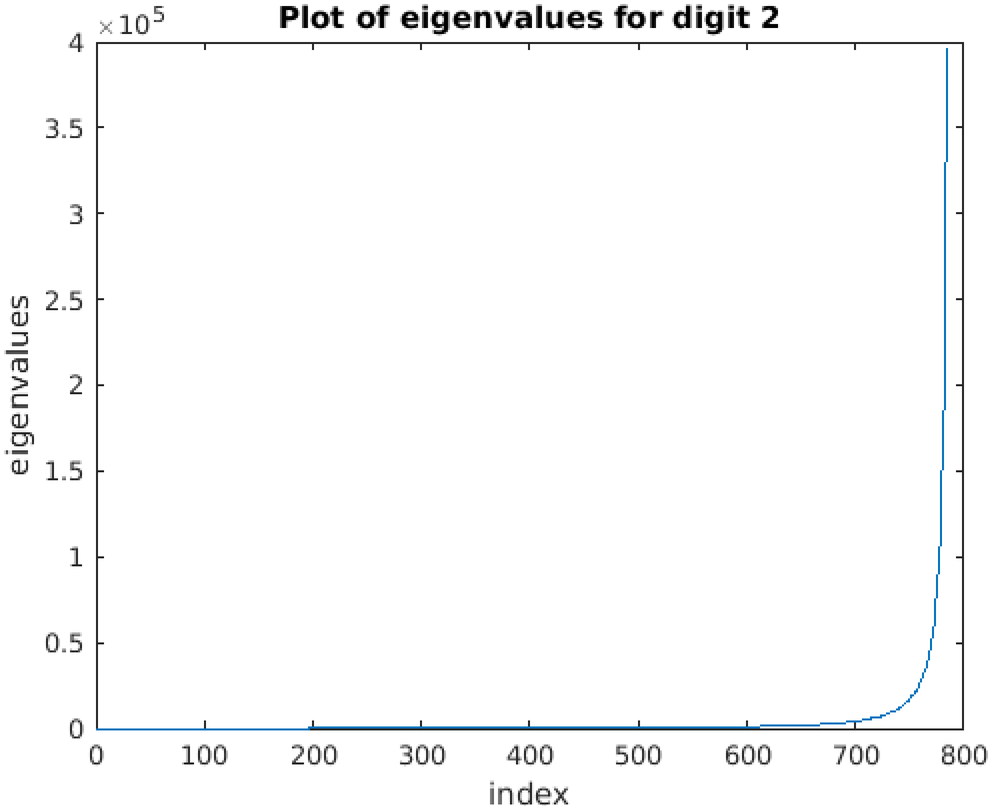
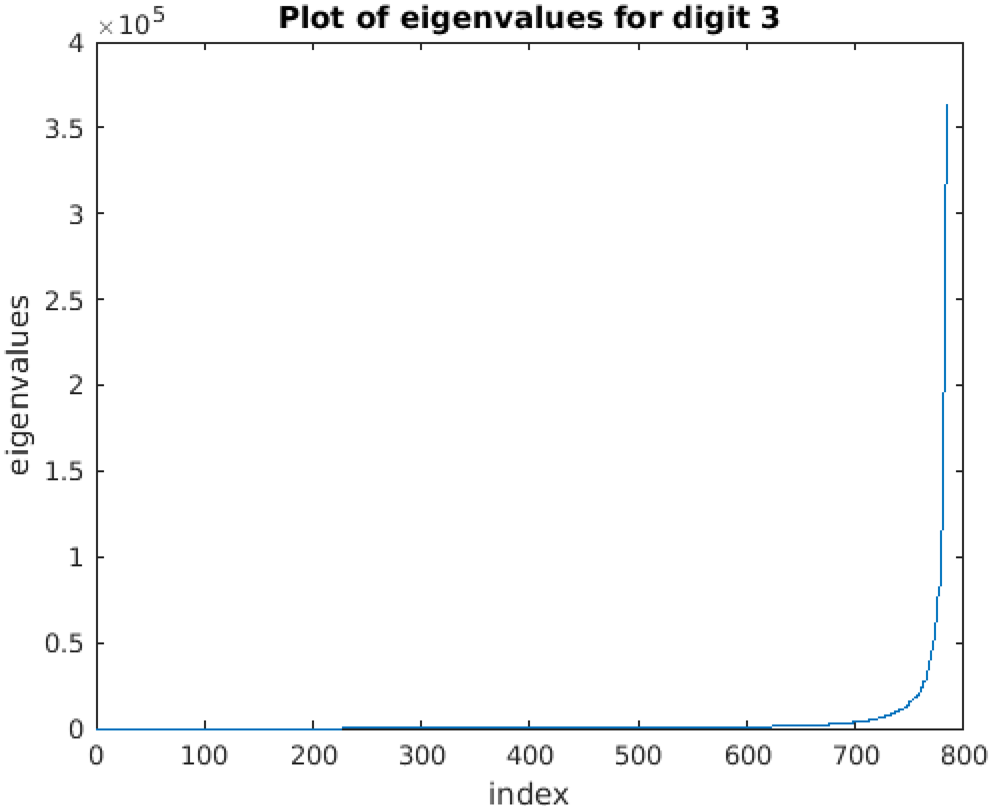


Plot of eigenvalues for digit 0
×10^5
6
5
4
3
2
1
0
-1
eigenvalues
0
100
200
300
400
500
600
700
800
index

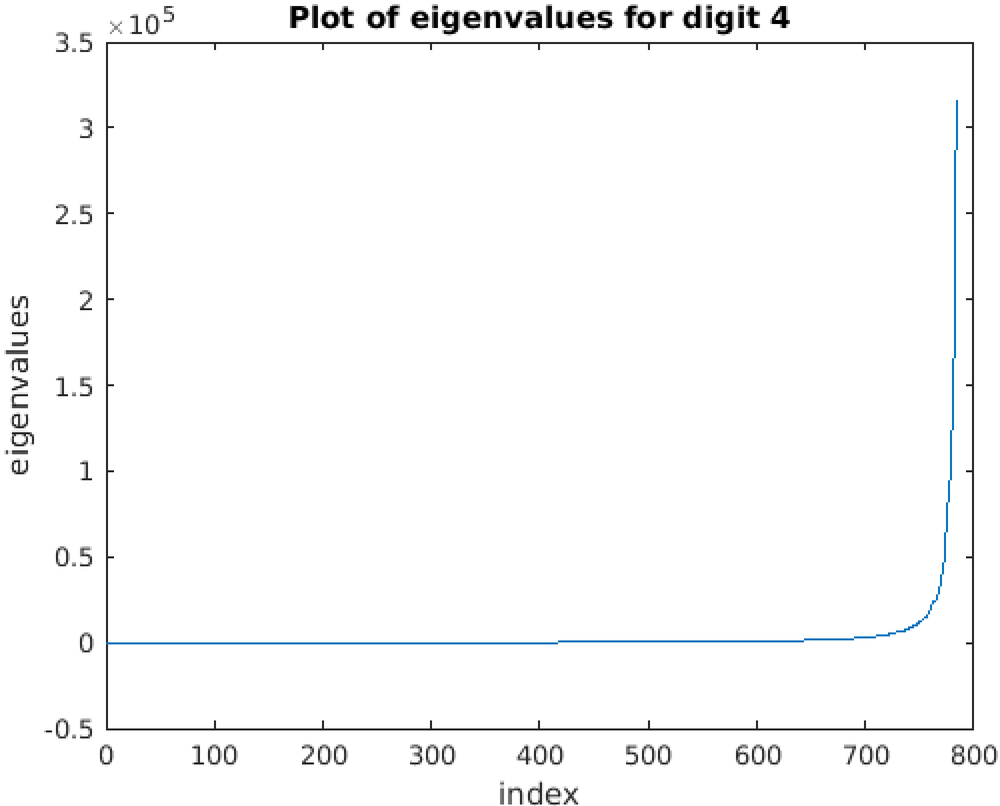


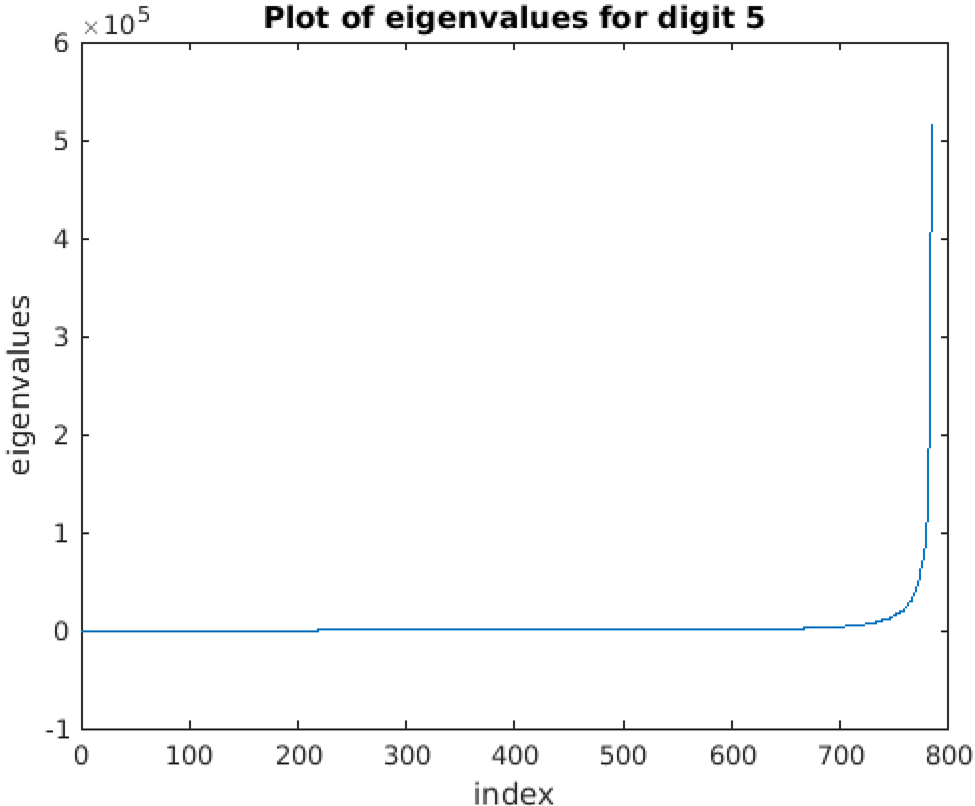
Plot of eigenvalues for digit 1
×10^5
6
5
4
3
2
1
0
-1
eigenvalues
0
100
200
300
400
500
600
700
800
index


Plot of eigenvalues for digit 2
×10^5
4
3.5
3
2.5
2
1.5
1
0.5
0
eigenvalues
0
100
200
300
400
500
600
700
800
index

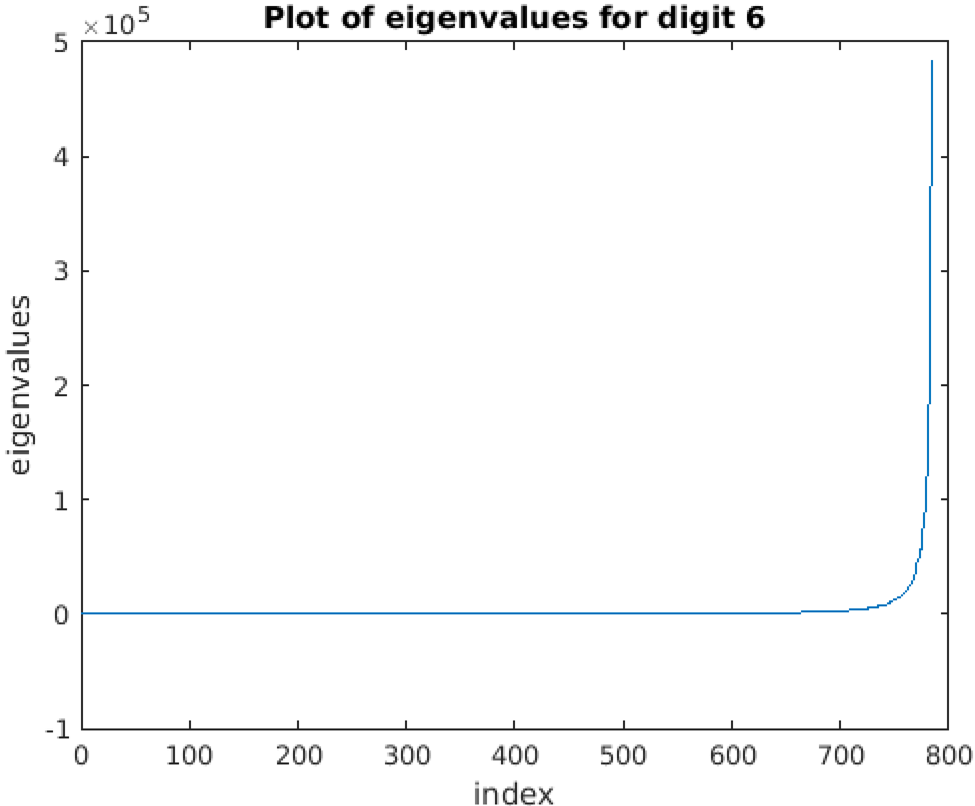


Plot of eigenvalues for digit 3
×10^5
4
3.5
3
2.5
2
1.5
1
0.5
0
eigenvalues
0
100
200
300
400
500
600
700
800
index

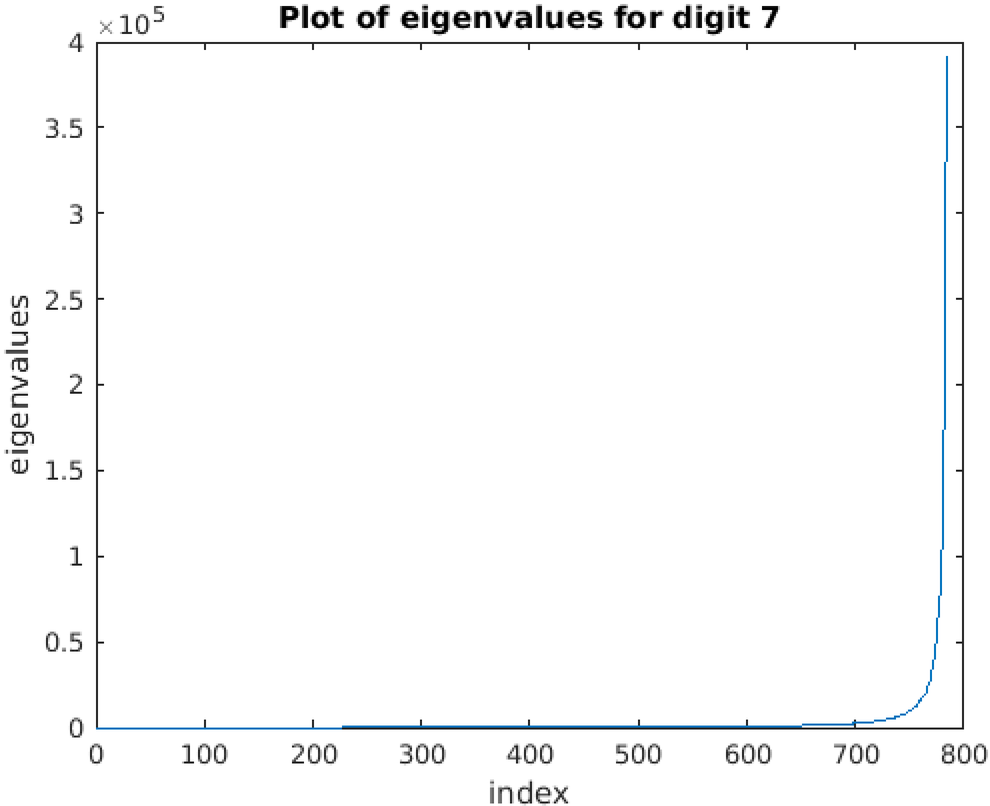

Plot of eigenvalues for digit 4
×10^5
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
eigenvalues
0
100
200
300
400
500
600
700
800
index

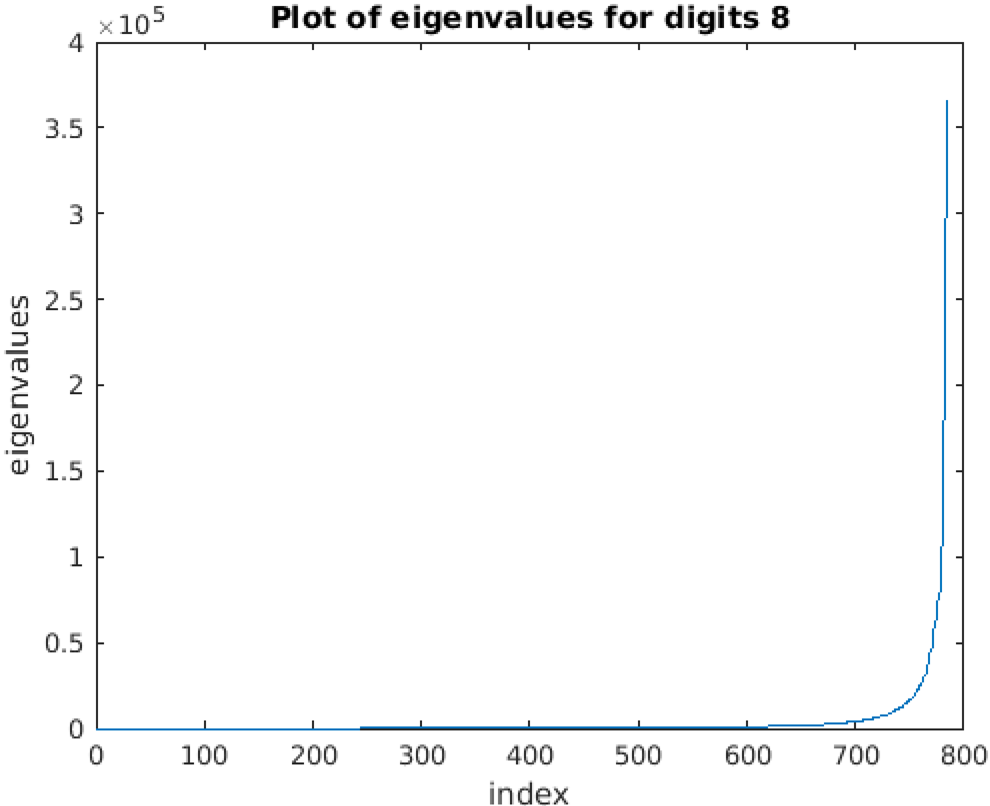


Plot of eigenvalues for digit 5
×10^5
6
5
4
3
2
1
0
-1
eigenvalues
0
100
200
300
400
500
600
700
800
index

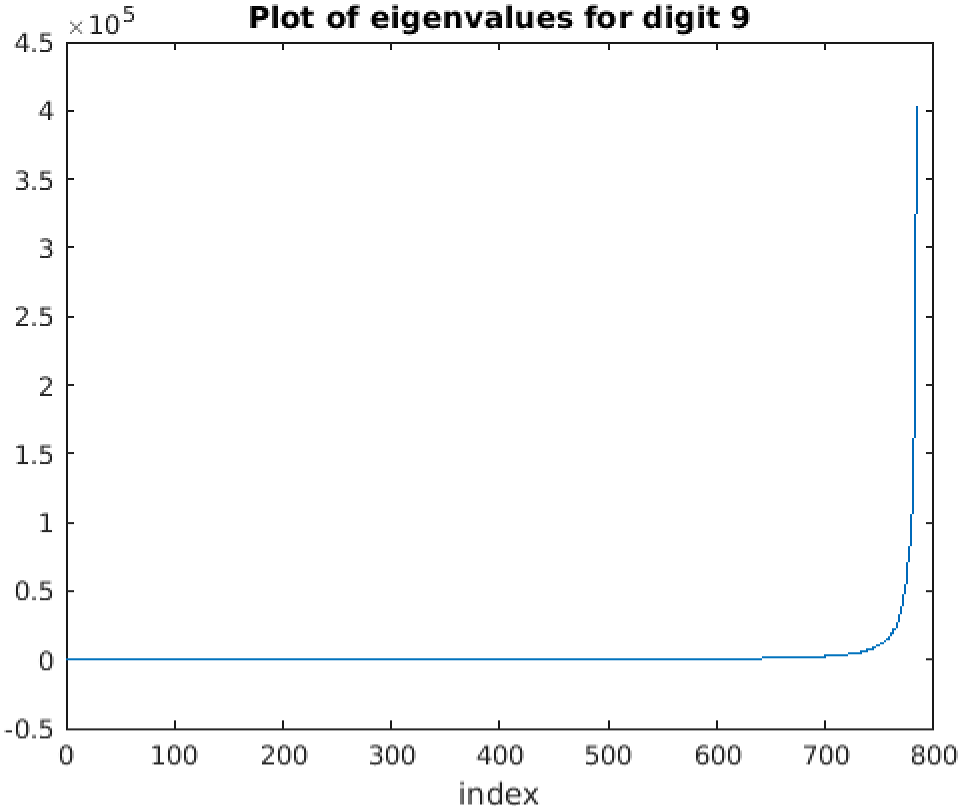


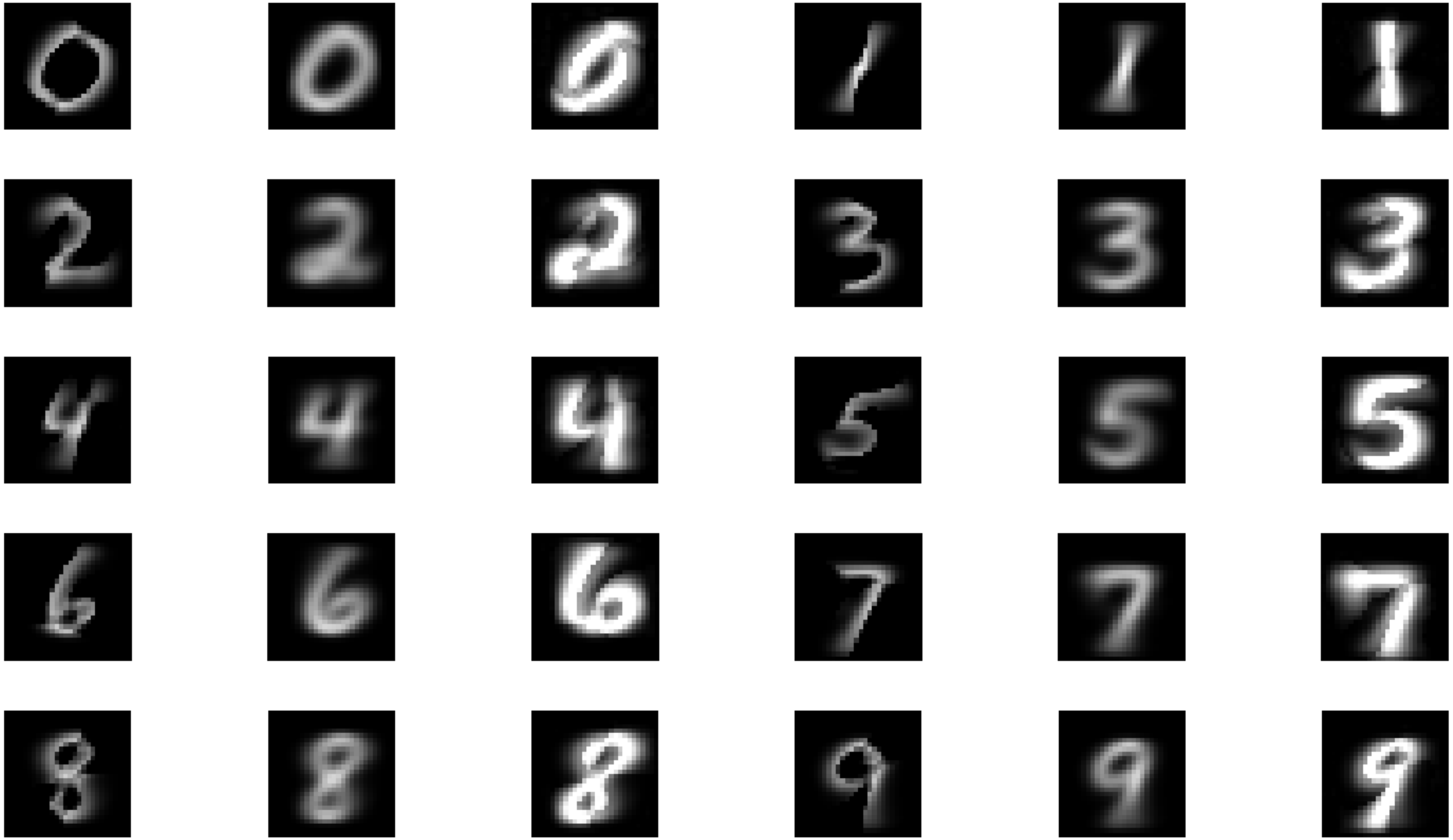
Plot of eigenvalues for digit 6
×10^5
5
4
3
2
1
0
-1
eigenvalues
0
100
200
300
400
500
600
700
800
index


Plot of eigenvalues for digit 7
×10^5
4
3.5
3
2.5
2
1.5
1
0.5
0
eigenvalues
0
100
200
300
400
500
600
700
800
index



Plot of eigenvalues for digits 8
×10^5
4
3.5
3
2.5
2
1.5
1
0.5
0
eigenvalues
0
100
200
300
400
500
600
700
800
index


Plot of eigenvalues for digit 9
×10^5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
eigenvalues
0
100
200
300
400
500
600
700
800
index



Problem 3.

(a) In the graphs we see that a lot of eigen values are small and some are very large. This proves the point that the modes of variation are not 28^2 but far less. The significant models of vibrations are far less than 784 (28^2) since most of people write similarly and hence most of pixels end up having values close enough in all the images. But some eigen values are very high which shows that there are suffient differences as well.

b) we see that '3' figures vary enough for distinctions to be observed.

The $\mu - sqrt(\lambda) \times v$ and $\mu + sqrt(\lambda) \times v$ are clearly very different for most of numbers. This is because the principal mode of variation is able to apture most of variation in group of images.

So not all people write in same fashion. For the number 1, this shows us that people write in different orientations.